

REMARKS/ARGUMENTS

A substitute specification is being filed in order to conform with U.S. practice. Headings have been added to the specification. Spelling and grammatical errors have also been corrected. The substitute specification contains no new matter. Amendments have been made to the claims to remove the multiple dependencies and an abstract has been added. An early action on the merits is respectfully requested.

If any additional fees are required in connection with this case, it is respectfully requested that they be charged to Deposit Account No. 02-0184.

Respectfully submitted,

René-Pierre Pont

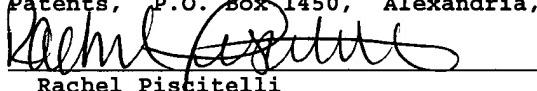
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**Abstract**

A process for producing a strip of aluminium or an aluminium alloy with a textured surface is such that, immediately after emerging from a cold rolling mill (17), a cold rolled strip (12) passed through the roll gap of two textured rolls bearing a rough-ness pattern and coiled, whereby the roughness pattern is transferred to the surface of the strip 10 as a result of the force of the textured roll acting on the strip (12).

A unit for producing a cold rolled strip of aluminium or an aluminium alloy with a textured surface is such that a texturing roll stand (28) with texturing rolls is arranged 15 immediately after the cold rolling mill (17), downstream in the direction of rolling (x).

Using the process and unit it is possible to dispense with a separate texturing roll pass and therefore save one rolling 20 pass compared with the state of the art method.

(Fig. 1)

## SUBSTITUTE SPECIFICATION WITH MARKINGS

### **Process and Unit for Producing an Aluminium Strip with Textured Surface**

#### BACKGROUND OF THE INVENTION

[0001] The invention relates to a process and unit for producing a cold rolled strip of aluminium or an aluminium alloy with a textured surface according to the description in the independent claims 1 and 5 comprising passing a cold rolled strip immediately after cold rolling through a roll gap of two textured rolls bearing a roughness pattern, wherein the roughness pattern is transferred to the surface of the strip as a result of the force of the textured rolls acting on the strip, and, thereafter, coiling the textured strip.

[0002] In the automotive industry strips and sheets of aluminium alloys are employed for the manufacture of bodywork parts, whereby the sheets are shape-formed by deep drawing or stretch drawing. Lubricants have to be employed to carry out this deep drawing and other shape-forming steps. By pre-coating the strips or sheets in the rolling mill not only is the forming procedure simplified, but also optimal protection during transportation achieved.

[0003] In a procedure commonly used today the strip manufacturer coats the cold rolled strip with an oil or a water-soluble dry lubricant and the prepared strip supplied to the sheet-forming company for the purposes of deep drawing.

[0004] In the case of an aluminium strip that has been produced in the normal manner using work rolls with a roll finish corresponding to a mill-finish surface texture, the lubricants exhibit relatively poor adhesion and distribution.

[0005] The adhesion and distribution properties of dry lubricants on the strip surface can be markedly improved by providing the surface of the strip with a roughness pattern. To that end the roughening of the strip surface is effected by transferring the roughness pattern on the work rolls to the surface of the strip during cold rolling of the strip.

[0006] Today, the roughness patterns provided on the surface of the aluminium strip to improve the adhesion and distribution of a dry lubricant there are produced by work rolls which are roughened e.g. by electrical discharge texturing (EDT), by electron beam texturing (EBT) or by the PRETEX method. All of these methods of roughening result in a surface texture with irregularly distributed, closed "lubricant pockets".

[0007] The above mentioned roughness patterns are produced on the surface of the strip in an additional cold rolling pass using a roll pass involving a small thickness reduction approx. 0.05 to 15%. In practice this additional cold rolling pass incurs correspondingly greater production costs. In addition, in order to produce the roughness pattern, it is necessary to change the work rolls that have a conventional roll-grind pattern for textured rolls.

[0008] A process and unit of the above mentioned kind is known from EP-A-O 945 198.

[0009] The object of the present invention is to provide a process and a unit of the kind described at the start, by means of which the production costs for manufacturing textured strips can be reduced. A further objective is to avoid the loss of capacity on a production unit caused by an additional texturing roll pass.

SUMMARY OF THE INVENTION

[0010] The object of the invention ~~with respect to the process~~ is achieved by way of providing a process and unit ~~having the features described in the independent claims 1 and 5~~ comprising passing a cold rolled strip immediately after cold rolling through a roll gap of two textured rolls bearing a roughness pattern, wherein the roughness pattern is transferred to the surface of the strip as a result of the force of the textured rolls acting on the strip, and, thereafter, coiling the textured strip.

[0011] With this process it is possible to dispense with a separate texturing roll pass and consequently save one roll pass compared with the state of the art method.

[0012] On performing the process according to the invention the cold rolled strip is drawn through the roll gap and the texturing rolls turned by the tension on the strip.

[0013] In order to adjust the thickness as uniformly as possible over the whole breadth of the strip, the texturing rolls are preferably set at a constant roll force.

[0014] To endow the strip surface with the above mentioned property whereby it acts as substrate for a dry lubricant, the texturing rolls are - to advantage - roughened using electrical discharge texturing (EDT).

[0015] It has been found that the process according to the invention is also suitable for smoothing cold rolled strips. To that end it can also be proved advantageous to provide the texturing rolls with the conventional, simple roll grind that results in the so called "mill finish" surface quality. The rolls are only ground over their outer surface direction, i.e. the roll grind comprises a plurality of parallel grooves distributed over the outer surface of the rolls.

[0016] Preferred is an arrangement in which the texturing rolls in the texturing roll stand are supported by intermediate rolls, which are in turn supported by backing rolls. The backing rolls may be arranged in several sets of rolls across the width of the intermediate rolls.

[0017] The backing rolls are preferably joined up in co-action to hydraulic pistons set at a constant force.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Further advantages, features and details of the invention are revealed in the following description of preferred exemplified embodiments and with the aid of the drawing; this shows schematically in

[0019] Fig. 1: the end view of a unit for producing a strip with a textured surface;

[0020] Fig. 2: the front elevation of a texturing roll stand;

[0021] Fig. 3: the cross-section through the roll arrangement of a roll stand shown in figure Figure 2.

DETAILED DESCRIPTION

[0022] A unit for producing an aluminium strip with a textured surface according to Fig. 1 comprises a cold rolling mill 17 with two work rolls 18, 20 forming a roll gap 19 and two backing rolls 22, 24 supporting the work rolls. The work rolls 18, 20 and the backing rolls 22, 24 are mounted in a mill stand 26 in a known manner.

[0023] Likewise installed in the stand 26 is a texturing roll stand 28 which is smaller than the cold rolling mill 17.

[0024] As shown in figures Figures 2 and 3, the texturing roll stand 28 exhibits two texturing rolls 38,40 which delimit a roll gap 39 and are supported by a pair of intermediate rolls 42, 44. Each pair of intermediate rolls 42, 44 is supported by five sets of three backing rolls 46, 48. The backing rolls 46, 48 are mounted in beams 50, 52 which extend over the width of the rolls. The upper beam 50 is supported by an upper part 54 of the roll stand frame via hydraulic pressure type pistons 58, the lower beam 52 lies directly on a lower part 56 of the roll stand frame. Both parts 54, 56 of the roll stand frame may be moved towards and away from each other by means of hydraulic raising or lowering pistons 60, 62 i.e. the roll gap 39 can be opened as

desired viz., when no texturing pass is required, or when the necessary dimension for a texturing pass is being adjusted. The roll force is adjusted via the hydraulic pistons 58 and thus the reduction in strip thickness during the texturing roll pass. The roll force is set by via the hydraulic compressive piston 58 and with that the reduction in thickness of the strip during the texturing pass.

[0025] In order to produce the surface texture pattern, a cold rolled strip coiled onto a reserve roll 14 is passed over a deflection roll 16 then fed in the rolling direction x to the roll gap 19 of the cold rolling mill 17. After it emerges from the roll gap 19, the strip 12 enters the roll gap 39 of the texturing mill stand 28. On leaving the texturing mill stand 28 the strip 12 is deflected around two further deflection rolls 30, 32 and coiled onto a spool 34. The thickness of the strip is checked by a thick-ness measuring device 36 situated between the texturing mill stand 28 and the second deflection roll 30. At the same time, the second deflection roll 30 serves to check the flatness of the textured strip 12.

[0026] The work rolls 18, 20 of the cold rolling mill 17 are driven and the strip 12 is drawn into the roll gap 19 by the rolls themselves. The texturing rolls 38, 40 are not driven, the strip 12 must be drawn through the texturing roll stand. This is done by the driven spool 34. The braking action of the texturing rolls 38, 40 results in a stress- regulating effect, which leads to better flatness in the textured strip 12.

[0027] The diameter of the texturing rolls 38, 40 is of course smaller than the diameter of the driven work rolls 18, 20 of the cold rolling mill 17. This produces a better texture in the strip surface with the result that a smaller reduction in thickness is necessary. The diameter of a texturing roll is e.g. around 350 mm.